# NITROGEN

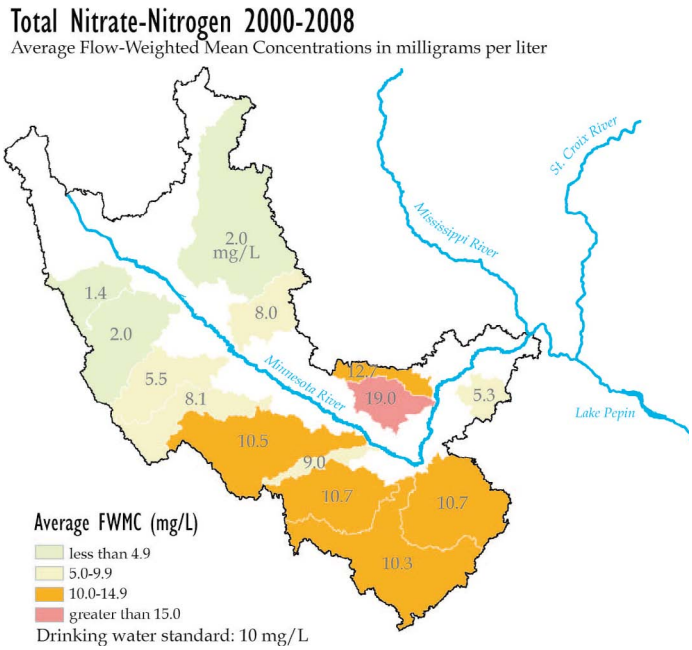
ASK an EXPERT
ABOUT THE MINNESOTA RIVER

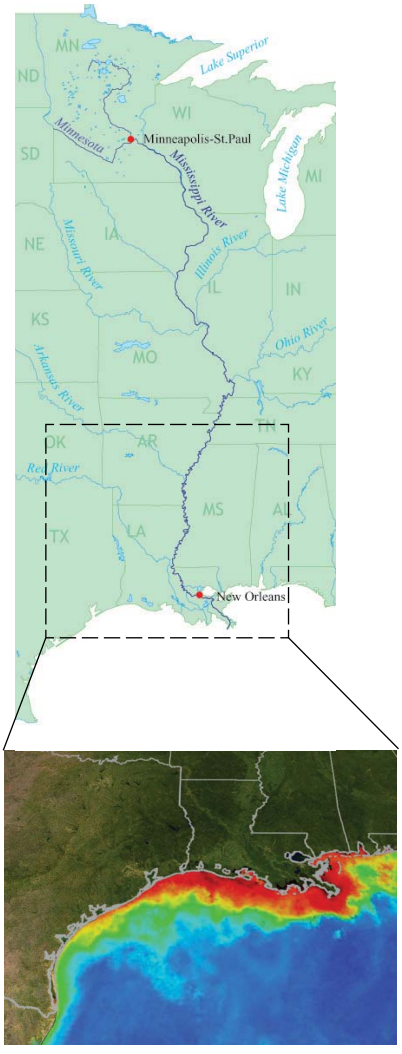
## What are Nitrates?

Nitrogen exists in the environment in many forms. Nitrate is the oxidized form of Nitrogen that is commonly found in the rivers and stream of the Minnesota River Basin. Because it is highly mobile, and biologically available, it is of special concern for aquatic systems. In recent decades, there has been a substantial increase in nitrogen fertilizer use. Elevated nitrate-N in the Minnesota River can pollute aquifers it recharges. Therefore, nitrogen can affect drinking water. At high enough concentrations, nitrate-N can cause infants who drink the water to become sick and even die (methemoglobinemia). Downstream, nitrate-N from the Minnesota River contributes to hypoxia (low levels of dissolved oxygen) in the Gulf of Mexico by stimulating the growth of algae which, through death and decay, consume large amounts of dissolved oxygen and thereby threaten aquatic life.

The predominant form of nitrogen in Minnesota River Basin streams is nitrate. Like phosphorus, nitrate can stimulate excessive levels of algal growth in streams. In recent years, this problem has been particularly severe in the Gulf of Mexico where development of a hypoxic zone (hypoxia means "low oxygen") has been linked to elevated nitrate levels carried to the Gulf by the Mississippi River. Reduced oxygen levels in the hypoxic zone, brought on by decomposition of algae, have damaged the shellfish industry and continue to threaten the aquatic ecosystem of the Gulf Region. The Minnesota River has been identified as a substantial contributor of excess nitrate to the Mississippi River and the Gulf Region.

Nitrate-Nitrogen (nitrate-N) concentrations vary substantially across the Minnesota River Basin. Nitrate-N levels are lowest in the western part of the Basin, elevated in the central portion and greatest in agricultural watersheds in the most easterly part of the Basin. The watersheds shown in orange and red have concentrations that exceed the drinking water standard (10 mg/L). Most of the nitrate-N in the Minnesota River comes from fertilizer, manure, and agricultural drainage.




*This image shows the hypoxic zone (sometimes referred to as the dead zone) in the Gulf of Mexico. Reds and orange indicate areas of low oxygen concentration. In July 2008, the hypoxic zone was mapped at 7,988 square miles – the second largest on record since measurements began in 1985. This is larger than the land area of the state of Massachusetts.*

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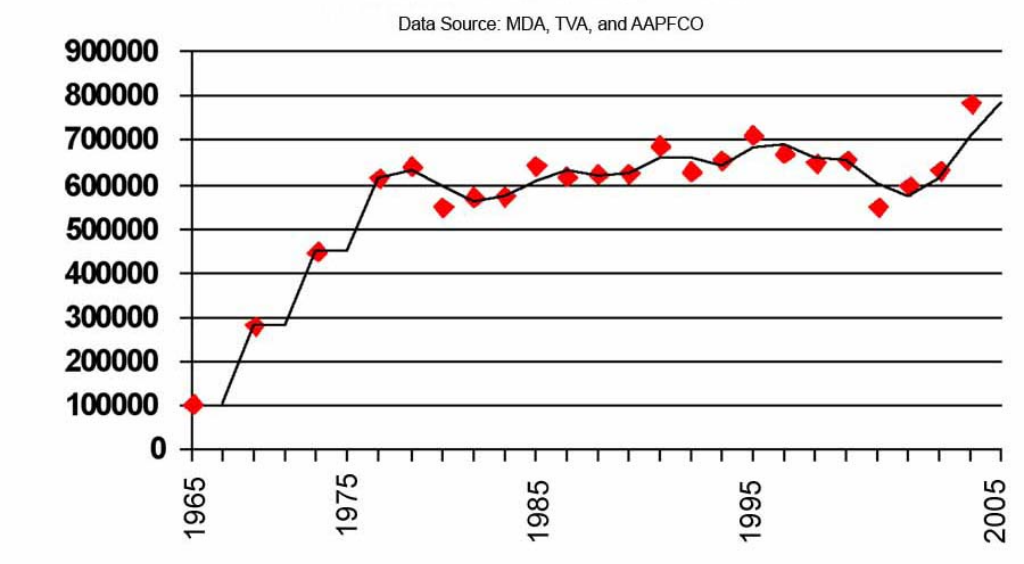
Post WWII there was an explosion of commercial fertilizer use across the US. The statewide fertilizer sales graph at right provides an indication of Nitrogen rates used by producers. Total annual Nitrogen sales in Minnesota during the same time period increased from 100,000 to 600,000 tons (Montgomery, 2008). This echoes the broader trend across the US as Nitrogen fertilizer usage rapidly increased from approximately 40 lb Nitrogen per acre from 1965 to 110 lb Nitrogen per acre in 1988 (Tennessee Valley Authority, 1988).


## Sources of Nitrogen

The primary sources of nitrogen in Minnesota's surface waters include: fertilizers, animal manure, municipal sewage wastes, agricultural and industrial wastes, atmospheric deposition, and dinitrogen fixation (as well as naturally occurring nitrogen) (Randall, Mulla, 2001). The transport of nitrate-N to surface waters can occur through base flow or subsurface drainage systems. The amount of drainage water leaving the landscape largely depends on climate and soil properties. Researchers frequently identify agriculture as a major contributor of nitrate-N to surface water. A common theme among numerous studies is that agricultural N remains a major component of total N export to rivers in the basin (Montgomery, 2002).




### Did You Know?

At the end of World War II the federal government scrambled to find a use for the vast amounts of ammonium nitrate stockpiled from making explosives for the war effort. As a result, munitions plants were converted into chemical fertilizer plants for agricultural crops (Pollan, 2006).

## Nitrogen Applied on Corn Acres

Average for Seven Mile Creek Watershed 2007

| | | |
|---|---|---|
| 157 lbs of Nitrogen applied per acre | Commercial Nitrogen 125 lbs | 82% Anhydrous Ammonia<br>9% Liquid & Urea<br>6% MAP/DAP |
| | Manure 32 lbs | 42% Dairy / 58% Hog |

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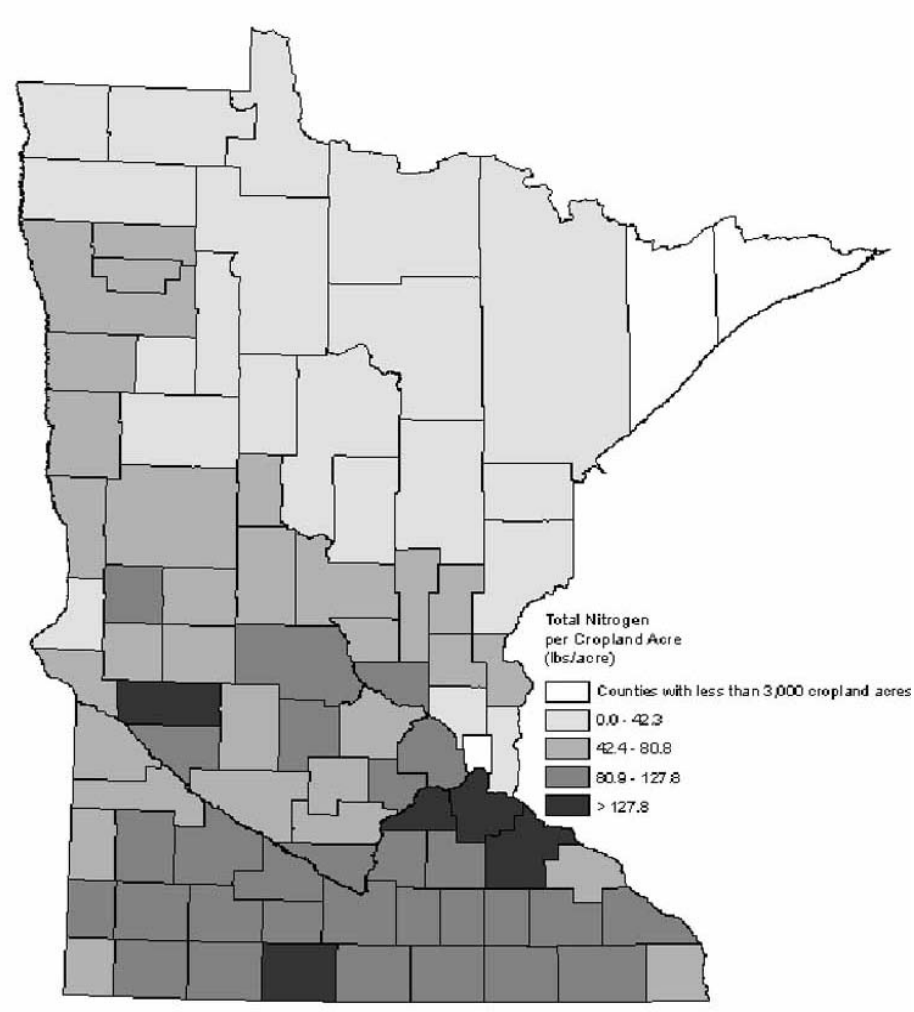
## Nitrogen Input Estimates

### Farm Scale Study

A 2007 farm study in Seven Mile Creek Watershed can serve as an example of nitrogen use in the basin. Eighteen farms totalling 9,183 acres of farmland were inventoried for the study. Corn acres accounted for 99 percent of the nitrogen applied and 100 percent of the manure applications.

Field corn accounted for more than 92 percent of the pounds of commercial nitrogen (N) fertilizer applied on the farms studied. Nitrogen applications to corn averaged 157 pounds per acre (see graphic below). All field corn acreage received either commercial N fertilizer or manure. Field corn received most of the N with 99 percent of the total applied. Field corn yield goal for these farms averaged 182 bushels per acre (Bu/Ac) and were consistent with the five-year historical averages of 172 Bu/Ac (MDA, 2007).




The map left depicts nitrogen input estimates based on 2002 Census data for county nitrogen fertilizer sales (point of sale), "fertilizer replacement" credits from manure and legume contributions. Inputs are averaged across all cropland acres within each county (Birr et al, 2008). The Minnesota River Basin stands out as a region with higher nitrogen inputs.

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"Ask an Expert about the Minnesota River" project profiles scientists and citizens answering questions about the health of the Minnesota River. More answers to questions about the Minnesota River can be found at: mrbdc.mnsu.edu/learn

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